

PIPE JOINT AND COUPLERS

RELATED APPLICATIONS

This application claims subject matter disclosed in U.S. provisional application Serial No. 60/414,551 filed September 27, 2002, the benefit of the filing
5 date of which is hereby claimed.

BACKGROUND OF THE INVENTION

This application relates to the art of relining sewers and, more particularly, to pipe joints and couplers that connect pipes used for relining sewers. Although the invention is particularly applicable to pipe used for relining sewers and will be
10 described with specific reference thereto, it will be appreciated that the invention has broader aspects and can be used in other environments and for other purposes.

Sewers commonly are relined while water continues to flow through the existing sewer. Adjacent sections of new pipe must be joined together in cramped quarters in a trench where it is difficult to work, and where the pipe end portions are
15 subject to being fouled by dirt. This makes it difficult to assemble a joint between adjacent pipe sections in an efficient and leak-tight manner. It would be desirable to have a pipe joining arrangement that is more efficient and less subject to leakage or contamination by dirt as compared with existing arrangements.

SUMMARY OF THE INVENTION

20 Adjacent sections of plastic pipe used for relining sewers are joined together by male and female coupler members. The couplers have cooperating cam surfaces that facilitate assembly of a joint by guiding a male coupler within a female coupler.

The male and female couplers have cooperating projections that cam past one another when the couplers are assembled and that restrain separation of the couplers
25 once they are assembled.

The couplers have splines that are adhesively bonded within annular sockets on pipe end portions.

An elastomeric gasket bonded to the external surface of the male coupler sealingly engages an internal surface on the female coupler.

- 5 The male and female couplers are configured for providing angular movement therebetween up to at least several degrees so that a string of pipe can be curved while maintaining integrity of the joints.

The gasket is prelubricated and wrapped in a protective covering that also provides protection against ultraviolet rays.

- 10 The cylindrical couplers are made by forming an extruded length of plastic strip into a generally cylindrical configuration and bonding the end portions together. The formed coupler ring then is heated and placed on a mandrel where it is allowed to cool for relieving stress therein and assuming its final generally cylindrical configuration.

- 15 It is a principal object of the present invention to provide an improved pipe joint between pipes used for relining sewers.

It is an additional object of the invention to provide improved coupler members used for joining adjacent pipe sections.

- 20 It is another object of the invention to provide an improved pipe joint that is capable of angular movement while maintaining integrity of the joint.

It is a further object of the invention to provide an improved gasketing arrangement for a pipe joint.

It is another object of the invention to provide a prelubricated gasket that is protected against contamination and ultraviolet rays.

It also is an object of the invention to provide an improved way of forming a generally cylindrical pipe coupler.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a prior art type of pipe used with the joint
5 and couplers of the present application, and with an end portion of the pipe in section for clarity of illustration;

FIG. 2 is a partial cross-sectional elevational view of the circled area of FIG. 1, and with the pipe rotated to stand on end with its axis vertical;

FIG. 3 is a partial cross-sectional elevational view of a female coupler in
10 accordance with the present application;

FIG. 4 is a partial cross-sectional elevational view of a male coupler in accordance with the present application;

FIG. 5 is a partial cross-sectional elevational view of an elastomeric gasket used with the couplers of the present application;

FIG. 6 is a partial cross-sectional elevational view showing the female coupler
15 of FIG. 3 connected to an end portion of the pipe of FIG. 1;

FIG. 7 is a partial cross-sectional elevational view showing the male coupler of FIG. 4 joined to an end portion of the pipe of FIG. 1, and with the elastomeric gasket of FIG. 5 installed on the male coupler;

FIG. 8 is a partial cross-sectional elevational view showing the male and
20 female couplers joined together;

FIGS. 9 and 10 are partial cross-sectional elevational views showing different angular positions of the male and female couplers relative to one another;

FIG. 11 is a partial cross-sectional elevational view showing the male and female couplers with cooperating projections that restrain separation of the joined couplers;

FIG. 12 is a partial cross-sectional elevational view showing the male coupler
5 with a lubricant coating the gasket, and with a plastic wrap over the gasket to protect same against contamination and against ultraviolet rays;

FIG. 13 is an end elevational view showing a strip of extruded coupler material formed into a generally cylindrical configuration for joining the ends thereof together;

10 FIG. 14 is a view similar to FIG. 13 showing the ends of the coupler strip joined together with bulges or burrs at the joint; and

FIG. 15 is a view showing the coupler strip of FIG. 14 after deburring and polishing, and being positioned on a cylindrical mandrel.

DESCRIPTION OF A PREFERRED EMBODIMENT

15 Referring now to the drawing, wherein the showings are for purpose of illustrating a preferred embodiment of the invention only and not for purposes of limiting same, FIG. 1 shows a prior art pipe of the type disclosed in U.S. Patent Nos. 3,926,223 and 5,096,529, the disclosures of which are hereby incorporated herein by reference. The pipe is made by helically coiling a hollow extrusion and bonding
20 adjacent coils together to form a pipe having cylindrical inner and outer surfaces 12, 14. The pipe peripheral wall between inner and outer cylindrical surfaces 12, 14 thereof has a helical hollow passage therein, and generally radially extending longitudinally-spaced walls 16 separate adjacent hollow passage turns from one another.

25 FIG. 2 shows an end portion of pipe A with several of walls 16 routed out to provide an annular cavity or socket 18 within the pipe end portion. The showing in

FIG. 2 is with the pipe standing on end and its longitudinal axis 20 extending vertically. Both of the opposite ends of the pipe are routed out to provide axially-extending annular sockets therein.

FIG. 3 shows a generally cylindrical female coupler B having a longitudinal
5 axis 30. Female coupler B has an annular barbed spline 32 extending generally parallel to axis 30. A female coupler portion 34 that extends generally parallel to axis 30 is displaced radially outwardly from annular barb portion 32, and has a smooth cylindrical outer surface 36 and a cylindrical inner surface 38. An end portion 40 of coupler portion 34 has a terminal end 42 opposite from barb portion 32. Terminal end
10 42 is inclined outwardly from cam surface 44 in a direction back toward spline end portion 50 at an angle of around 20° to a radial line from coupler axis 30. An annular cam surface 44 is inclined from terminal end 42 toward axis 30 in a direction back toward barbed portion 32. Cam surface 44 lies on the surface of a cone and is inclined at an angle of around 20° to cylindrical outer surface 36.

15 Inner cylindrical surface 38 of coupler portion 34 intersects cam surface 44 at a radially inwardly extending projection 46 to provide a shoulder 48 that extends generally radially of axis 30 and faces back toward barbed spline 32. Inner cylindrical surface 38 intersects barbed end portion 50 at smoothly curved concave internal shoulder 52 that merges with a straight surface 52a that is inclined at an
20 included angle of around 20° with a radial line from the coupler axis. Shoulders 54 and 56 extend generally radially inwardly and outwardly from barbed end portion 50.

FIG. 4 shows a male coupler C having an annular barbed spline 60 extending parallel to longitudinal axis 62 on a spline end portion 63 having shoulders 64, 66 extending generally radially inwardly and outwardly therefrom.

25 Male coupler C has a generally cylindrical coupler portion 67 extending in an opposite direction from barbed end portion 63 and displaced radially inwardly from barbed spline 60. Coupler portion 67 has a smooth cylindrical inner surface and a cylindrical outer surface 70. Coupler portion 67 has an end portion 72 opposite from

barbed spline 60 and a terminal end 74 that is inclined inwardly from cam surface 76 at an angle of around 20° to a radial line from coupler axis 62. An inclined annular cam surface 76 extends from terminal end 74 in a direction away from longitudinal axis 62 and back toward barbed portion 60. Cam surface 76 lies on the surface of a cone and is inclined to cylindrical inner surface 68 at an included angle therewith of around 20° . Cylindrical outer surface 70 intersects a concavely curved annular portion 75 which in turn intersects a straight surface 75a that is inclined at an included angle of around 20° with a radial line from the coupler axis.

A generally rectangular outer circumferential groove or recess 80 is provided in coupler portion 67 adjacent end portion 72 thereof. Groove 80 intersects cam surface 76 at a radially outwardly extending projection that provides an annular shoulder 82 forming one radially extending sidewall of groove 80. The opposite side of groove 80 has a groove sidewall 84 intersecting an inclined cam surface 86 on a projection 88 that extends radially outwardly from coupler portion 67 to provide a radially extending shoulder 89 that faces toward spline end portion 63. Inclined surface 86 is inclined approximately parallel to cam surface 76.

FIG. 5 shows an annular gasket D of elastomeric material having a base portion 90 and a deformable lip portion 92. Cylindrical inner surface 94 of gasket D includes a plurality of axially-spaced circumferential recesses 95, 96 and 97. Leading inclined gasket surface 102 is inclined at an included angle with cylindrical inner surface 94 of around 50° . The terminal end of sealing lip 92 is smoothly curved at 104 and intersects with a backwardly inclined surface 106 that is inclined at an included angle to the horizontal of around 70° . Backwardly inclined surface 106 is smoothly curved outwardly as at 108 to merge with a generally flat cylindrical surface 110.

Within a joint, surface 102 is the gasket surface that is subjected to water pressure from inside of a pipe while rear surface 106 is possibly subjected to pressure from ground water and/or from grouting of the new pipe within the host pipe.

Cylindrical inner surface 94 is glued to the bottom of groove 80 in FIG. 4, preferably with an adhesive that does not build gasket height such as a cyanoacrylate. Recesses 95-97 provide glue channels to enhance bonding of the gasket to the male coupler.

5 Rear end 112 of gasket D extends generally parallel to radial sidewall 84 of groove 80 and helps to restrain the gasket against movement during installation of a male coupler within a female coupler so that excessive stress is not applied to the adhesive joint between the gasket and the male coupler. Front inclined surface 102 intersects flat cylindrical inner surface 94 at a generally sharp but curved intersection 114.

10 Gasket D is spaced from end 74 and cam surface 76 so it is protected from damage when joints are made. If the coupler ends collide while being aligned to make a joint, the gasket is out of harms way and protected against damage.

15 Couplers B and C are attached to a pipe A by routing out an annular cavity to provide an annular socket as described with reference to FIG. 2. When pipe walls 16 are routed away to form annular sockets 18 in the pipe end portions, there is an opening into the hollow helical passage within the pipe wall. This opening is plugged with backer rod or in any other suitable manner such as with a foam plastic plug. Hot melt adhesive or a two-part epoxy then is placed within annular socket 18 with pipe A standing vertically.

20 A spline portion 32 or 60 of a coupler then is plunged into the unsolidified adhesive within socket 18 until shoulders 54, 56 or 64, 66 abut the outer end of the pipe adjacent socket 18. Hot melt adhesive at least partly melts and burns into the plastic of pipe A and of a coupler to fuse therewith and firmly bond a coupler to a pipe when the adhesive solidifies or cures. Each pipe has a male coupler attached to
25 one end portion thereof and a female coupler attached to the opposite end portion thereof.

The amount of adhesive placed in a socket is calculated so that the adhesive fills the socket cavity when a spline is plunged into it. Hot melt adhesive forms both a thermal bond and a mechanical interlock to resist forces in all directions. The adhesive also creates a vacuum tight and pressure tight seal between the coupler and pipe. The annular pipe sockets are routed out ten to fifteen percent deeper than the axial length of a spline to allow movement of adhesive from one side to the other before curing.

Pipe having male and female couplers attached thereto is shown in FIGS. 6 and 7. The solidified hot melt adhesive or epoxy adhesive is generally indicated by number 120 in FIGS. 6 and 7. As shown in FIGS. 6 and 7, outer cylindrical surface 36 of female coupler B is substantially flush with cylindrical outer surface 14 of pipe A. Likewise, inner cylindrical surface 68 on male coupler C is substantially flush with inner cylindrical surface 12 of pipe A.

In the preferred arrangement, the diameter of outer cylindrical surface 36 on female coupler B is not larger than the diameter of pipe outer cylindrical surface 14, and the diameter of male coupler inner cylindrical surface 68 is not smaller than the diameter of pipe inner cylindrical surface 12. Thus, the coupling arrangement does not provide any external enlargement between adjacent pipe sections and does not reduce the internal size of the pipe internal passage.

Axial forces applied for pushing long strings of pipe are maintained generally axially of the pipes by elongated splines 32 and 60 so that the inner or outer pipe walls do not break or telescope.

Radial shoulders 54, 56 and 64, 66 firmly engage the pipe ends to transfer column loads between the pipe and couplers. The entire spline end portions 50, 63 define strong bulkheads on the couplers to withstand large forces and to transfer such forces. Inclined surfaces 52a, 75a are engaged by cooperatively inclined coupler ends 74, 42 to prevent the couplers from telescoping past one another when high column loads are applied to a pipe string. The higher the load, the tighter the engagement

between female coupler end 42 and male coupler surface 75a, and between male coupler end 74 and female coupler surface 52a.

FIG. 8 shows female and male couplers B, C joined together with gasket D deformed to the configuration shown in FIG. 8 by engagement with internal
5 cylindrical surface 38 on female coupler B. Sealing lip 92 on gasket D is deformed to a generally horizontal configuration.

Annular cam surfaces 44 and 76 on female and male couplers B, C cooperatively engage one another to facilitate assembly of the couplers to the position shown in FIG. 8. Projections 46 and 88 on female and male couplers B, C have an
10 interference fit with one another so that some force is required to move the projections past one another in assembling the joint. Cooperation of projections 46 and 88 then restrains the couplers against longitudinal separation as shown in FIG. 11. When pipe initially is installed, pipe sections may float downstream and cooperation between projections 46, 88 holds the joints together as indicated in FIG. 11. However, a joint
15 can be manually separated by angularly articulating a joint and/or using additional separating force.

After a string of pipes have been joined together in relining a host pipe, axial force is applied to the pipe string for collapsing all the joints to the general position shown in FIG. 8. The radial space between the exterior of the new pipe and the
20 interior of the host pipe then is filled with grout that is injected under pressure. The grout normally will enter the space between coupler inner surfaces 38, 70 through a clearance opening between terminal end 42 on female coupler portion 34 and surfaces 52, 52a on male coupler C.

The joint of the present application is articulatable as shown in FIGS. 9 and 10
25 so that the axes of adjacent pipe sections can be skewed relative to one another up to several degrees. This permits imparting curvature to a pipe string while maintaining the integrity of the joints.

FIG. 12 shows a lubricant such as a silicone lubricant 130 applied to inclined leading surface 102 on gasket D. A plastic stretch film 134 that contains ultraviolet ray inhibitors is tightly wrapped around the end portion of male coupler C over gasket D and the coupler end portion. This protects the gasket and the lubricant during storage of pipe in a storage yard, and during handling preparatory for installation within a trench. Just prior to making a joint, a worker can tear off stretch wrap 134 to expose a clean and prelubricated gasket for reception within the female coupler.

The couplers are extruded to the cross-sectional shape described as an elongated strip. Appropriate lengths of strip then are cut and bent into a generally cylindrical shape as shown in FIG. 13. Ends 150, 152 then are heated by suitable heating device 154 to near the melting point thereof. Softened ends 150, 152 then are butted together and pressure welded so that the plastic material fuses into a joint as generally indicated at 160 in FIG. 14.

Internal and external longitudinal bulges 162, 164 usually will be formed at the joint. These bulges are removed by deburring and polishing equipment to provide smooth cylindrical surfaces. The entire ring then is heated and placed on an appropriately shaped cylindrical mandrel 170 in FIG. 15. The ring that forms coupler B then is allowed to cool for relieving stress therein, to provide a relatively rigid finished cylindrical coupler of suitable rigid plastic material such as polyvinylchloride that also is known as PVC. Coupler C is formed in the same manner.

The coupling arrangement of the present application provides a lap type of joint and there is nowhere for water to be trapped within the joint so that the joint is easily slammed together once the male coupler has been started into the female coupler.

Installation of liner pipe into a host pipe with live flow is difficult because the pipe is pushed around, and bobs up and down in the flow. When a host pipe is running up to around 50% full of water, it is not possible to see the bottom half of the

pipes being coupled. In the arrangement of this application having cam surfaces 44, 76, up to around 60% of the pipe wall thickness between inner and outer surfaces 12, 14 is effectively open to funnel the male coupler within the female coupler. The high strength rigid PVC used for the couplers minimizes the possibility of damage to the
5 coupler ends.

Field assembly of custom pipe lengths can be done by cutting a pipe to a desired length and routing out the ends. The pipe may have male or female couplers attached to both ends, or may have a female coupler attached to one end and a male coupler attached to the opposite end. Two part epoxy is more convenient for securing
10 coupler splines within the routed sockets in the field.

Although the invention has been shown and described with reference to a representative embodiment, it is obvious that alterations and modifications will occur to others skilled in the art upon the reading and understanding of this application. Therefore, it is to be understood that the invention may be practiced otherwise than as
15 specifically described herein while remaining within the scope of the claims.